digitalization has long been an integral part of our lives, the business world and society - but what exactly is it? Why is the speed of change constantly increasing? And why is the iPhone a good example of this development?

EXPONENTIAL TECHNOLOGIES / LESSON 1 FROM 8

Moore's Law and the Law of Accelerating Returns

To truly understand digitalization, you need a basic understanding of exponential growth and its impact on digital technologies. As an expert on the subject, Pascal Finette from the Singularity University in the Silicon Valley shares important insights with you, using Moore's Law to explain how exponential growth is already changing the world today.

Learning contents

- **Moore’s Law**
- **Computing power increases as the size decreases**
- **The accelerating rate of change**

Hi, I'm Pascal Finette.

I am Singularity University's Track Chair for

Entrepreneur Partnership and Open Innovation,

and before we dig into our course today,

let me tell you a tiny little bit about myself.

I am what you would call a serial

entrepreneur, though I hate that term,

I've founded four startups

and sold a few of them,

I founded three nonprofits

by now, I ran an art gallery,

I worked at some of the most

interesting tech-companies,

like eBay in their formative years in Europe,

Mozilla, the maker of the Firefox web-browser,

as well as Google, and I

co-founded a venture capital firm.

That's why I am your expert for
exponentially accelerating technologies,
and this is my
Masterplan.
Alright, let's talk about change and
let's talk about exponential change,
and when you talk about exponential change,
the first thing you need to talk about is Moore's Law.
Gordon Moore,
co-founder of Intel,
50 years ago told us that the number of transistors
on an integrated circuit doubles every two years.
Practically meaning: your computer, at the same
price point, gets twice as fast every two years.
Let me put this into a little bit of a
perspective to make it easier for you to grok.
There's a computer called ASCI Red, it was
released in 1979, built by the US-military,
the first computer humans ever built to
break through the one teraflop barrier.

1.3 teraflops, which is a trillion
floating point operations per second.
It cost us 55 million dollars and
we used it to calculate the weather.
A couple years later, 2006, you go
into your favorite electronic store,
you buy a PlayStation 3, that thing
has 2.1 teraflops - for 500 dollars.
There's another interesting thing
happening: computers get smaller.
There's a computer called Pi Zero,
it costs about five bucks,
was released in 2015
and has 191 megaflops.
That's about two and a half times
the compute power of a Cray One.
Cray One was released in the mid-1970s,
it was the first real supercomputer we had,
and each of those Cray Ones
had more compute power
than all of NASA had combined

to put the man on the moon.

So literally for a

cup of coffee now,

you get two and a half times the compute

power NASA had to put the man on the moon.

Of course that requires you believing

that we ever put the man on the moon,

but I will say no

more about that.

And then computers

get super small.

There's now computers which cost you

50 cents and they're the size of a grain of sand,

And they power the thing which

is called the "Internet of Things".

You will get smart toasters,

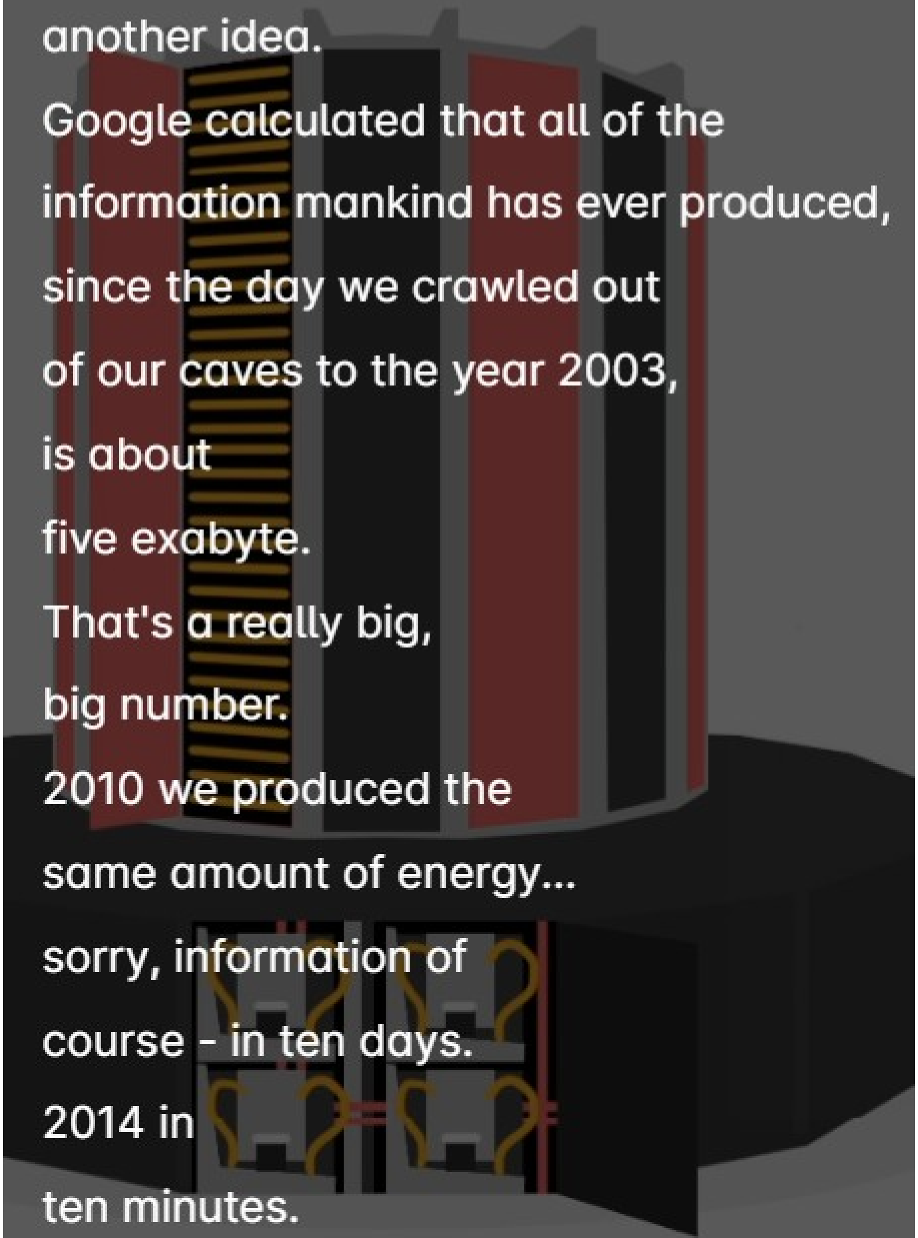
if you like them or not,

for the simple reason that these

things are so incredibly cheap.

We will see billions of

those devices in the world.



Let me give you
another idea.
Google calculated that all of the
information mankind has ever produced,
since the day we crawled out
of our caves to the year 2003,
is about
five exabyte.
That's a really big,
big number.
2010 we produced the
same amount of energy...
sorry, information of
course - in ten days.
2014 in
ten minutes.
That is what's called
exponential growth.
Ray Kurzweil, one of the legends in
the AI-field - artificial intelligence,

formulated something called the
"Law of Accelerating Returns".
What he effectively
says is two things.
The first is: Ray found out that the
underpinnings of Moore's Law,
the idea that at the same price point
I get twice as much compute power,
has been true for more than a 110 years,
so not just 50 years, a 110 years.
And the other thing he found is that
the rate of change itself is accelerating,
we see more and more
change in the world.
In the next 100 years we will
see the same amount of change
that we saw in the
last 20.000 years.
And what this means is, you can
extrapolate this graph out into the future,
you can determine the point in time when we

will have a computer for a thousand dollars
which has the raw compute power of
your brain - which happens in 2029.
And then it gets really interesting,
because then we'll double, right?
We go from one brain to two, to four,
to eight, to sixteen and by 2050, 2060,
you've got 7.4 billion brains, all
of mankind, in your smartphone.
That is to say: the phone in your pocket
will soon be smarter than you are.
Here is an interesting story: the brothers
Wright flew their first plane in 1903.
73 short years later we could
fly supersonic for the first time,
from London to New
York in the Concorde.
There were people on this planet who remember
us not flying at all and now flying supersonic.
What took us decades

back in the time
will now take
us years,
and probably only months
and soon only days.
The most important thing
for you to understand
is that tomorrow will look
dramatically different than today.
And when I say tomorrow I'm not saying tomorrow,
five years from now or ten years from now,
I'm saying tomorrow
in 24 hours.